## REMARKS

Claims 19-38 are now in the application. Claim 19 has been amended to recite a pH of about 5 to about 11 to render it consistent with the specification such as page 3, lines 27-28. In addition, claim 19 has been amended to clarify that the static etch rate recitation refers to the oxidizing agent.

Claims 19-24, 26-27, 32-33 and 37-38 were rejected under 35 U.S.C. § 103(a) as being unpatentable under U.S. Patent 5,770,103 to Wang, *et al.* (hereinafter also referred to as "Wang"). Wang does not render obvious the present invention. By way of background, the present invention relates to a method for polishing a surface and especially those surfaces employed in microelectronics. The method of the present invention employs a slurry composition that is capable of polishing both metal and silicon dioxide at substantially equal rates (see page 1, lines 7-9). The slurry compositions employed in the method of the present invention comprise abrasive particles and an oxidizing agent having a static etch rate on metal of less than 1000 Å per hour and having a pH of about 5 to about 11.

As discussed in the specification, the present invention provides a method that is capable of removing the topography and scratches created during the polish of a prior level of metallization.

In the manufacture of a semiconductor device, the wires for the chip in the "back end of the line" (BEOL) are usually formed by the so-called cloisonné process. In this process, the metal is uniformly deposited on the wafer, patterned with a mask, and then etched with a plasma reactive ion etch (RIE) tool to leave the metal isolated in regions where one desires the wires. Then the dielectric material is deposited, and polished using chemical mechanical planarization (CMP) to leave the conductors properly separated. One of the benefits of this process of forming the wires is that since the plasma RIE removes material on a "line of site", it is affective in removing the metal that might be deposited in topography that originated from a process operation at a prior level.

However, to both reduce cost and to utilize different, low-resistance materials for the construction of the metal wires, the cloisonné process is being replaced by the damascene process to form the wires in the BEOL. In this reverse process, the dielectric is first uniformly

deposited, patterned with a mask and etched. Then the metal conductor is uniformly deposited such that it forms a conformal film over the entire wafer and fills the patterns that have been etched into the dielectric. Then, using CMP, the excess surface metal is removed to leave the wires filled with metal. One of the problems with this process is since the metal is removed via CMP, which planarizes as it removes the excess material, residual metal can remain in topography that has been created at prior levels. That is, if there is a scratch or erosion in the dielectric, the metal will fill that void and cannot be removed easily via CMP without considerable over polish and the resulting damage that it introduces.

A specific example where this change in methodology of creating the wires is necessary is the manufacture of semiconductor devices with copper BEOL wiring. Since there is no viable process for etching copper currently available, it is a preferred technique to form the lines with the damascene process. In such a case, the local wiring of the semiconductor devices (that is at the lowest levels of the chip), usually utilizes tungsten as the conductor, which is then connected to the more global wiring in the BEOL, which is made of copper. In this specific example, it is found that erosion or scratching of the oxide dielectric at the last tungsten level replicates up and to the ensuing copper levels. The areas of erosion then lead to "puddles" of residual copper, and the scratches leave "stringers" of the copper, each of which if not removed at the copper CMP step would cause short-circuits. If these puddles or stringers are removed during the copper CMP step, it adds considerable processing time for the "overpolish."

Since the removal of all of the surface metal is essential to eliminate the short circuits and because the damascene process is sensitive to both the material and underlying topography of those materials, it is clear that the surface of the wafer must be highly planar (i.e., no existing topography) prior to the deposition of the metal. The obvious method of achieving this polarity is to polish the dielectric into which the metal will be inlaid to create a smooth, scratch-free film prior to metal deposition. However, this has the disadvantage that it would necessitate additional process steps (polishing and cleaning) and would result in a highly variable dielectric, and hence, conductor thickness. This would cause the undesirable result of having a variable resistance for the circuit.

The present invention overcomes problems in the prior art. More particularly, as discussed above, the present invention employs a slurry composition that is capable of removing

the topography and scratches created during the polish of a prior level metallization. The slurry composition employed according to the present invention, as discussed above, can polish both metal and silicon at equal or substantially equal rates.

Wang fails to render obvious the present invention, since among other things, Wang fails to suggest selecting a pH of about 5 to about 11 along with selecting an oxidizing agent having a static etch rate on metal of less than 1000 Å per hour. On the other hand, Wang suggests employing a slurry having a pH of 1 to about 7 and employing an oxidizing agent such as nitrates, iodates, chlorates, perchlorates, chlorites, sulphates, persulphates, peroxides, ozonated water and oxygenated water. Many of these oxidizing agents exhibit etch rate significantly greater than that recited in the claims. Moreover, none of the examples in Wang employ a slurry composition having a pH of at least about 5 along with an oxidizing agent having a static etch rate or metal of less than 1,000 Å per hour. It has been found according to the present invention that both the pH and type of oxidizing agent, are judiciously selected in order to achieve the results obtainable by the present invention and namely to obtain polishing of both metal and silicon dioxide at equal or substantially equal rates.

On the other hand, the polishing compositions and technique suggested by Wang result in achieving much higher metal etching rates. In fact, the objective of Wang is to achieve very high polishing rates for metal as contrasted to the results obtainable by the present invention. The objective of Wang is to provide a slurry for removing titanium and other metals while suppressing the rate of removal of silicon (for instance, see column 3, lines 1-7 thereof). To etch metal and silicon dioxide at substantially the same rate would be contrary to the desires of Wang.

The conclusion in the Office Action that "it would have been obvious to have the same effect such as the same etch rate as claimed because all the process constituents such as the abrasive and the oxidizing agent used by Wang, *et al.* is exactly similar with the applicant and expected to have the similar effect." is in error. To begin with, as discussed, nothing in Wang leads to employing a composition having the same abrasive, oxidizing agent, and pH as recited in the present claims from all of the possible combinations suggested by Wang.

The law is well settled that claiming of a more specific range within a more generic range and/or claiming species from a broader group of possible compounds avoids the invention from being exactly the same as the prior art. The test employed is whether the claims read on the prior

art disclosure, not on what the references broadly teach.

For example, see *Akzo N.V. v U.S International Trade Commissioner*, 1 USPQ2d. 1241 (Fed. Cir. 1986). In *Akzo*, claims that were drawn to a process for making aramid fibers using a 98% sulphuric acid were not anticipated by reference using a concentrated sulfuric solution but which did not specifically disclose that it was a 98% concentrated sulfuric acid solution.

The Court further found that no anticipation exists when one would have to "randomly pick and choose a number of different polyamides, a plurality of solvents and a range of inherent viscosities" to reach the claimed invention.

In *Rem-Cru Titanium v. Watson*, 112 USPQ 88 (D.D.C.-1956), the prior art showed alloys having broad ranges which included the claimed ranges. However, the prior art did not specifically disclose the more limited claimed ranges or alloys having the characteristics of the claimed alloy, which is analogous to the present case. Accordingly, the Court held the claims to be allowable. For a similar fact pattern and same holding, please see *Becket v. Coe* (CA, DC 1938) 38 USPQ2 and *Terak v. Watson* (DC-DC 1954) 103 USPQ78. Also, see *Minnesota Mining & Manufacturing Co. v. Johnson & Johnson Ortho-Paedics, Inc.* (24 USPQ2d, 1321 Fed. Cir. 1992). Here the Court held that although the claims may be subsumed in a prior art reference generalized disclosures, this is not literal identity. The reference ranges provided no guidelines on how to construct a product with the inventions attributes.

An invention cannot be rejected based on inherency because of probability of possibilities of the presences of the constituents in the prior art. *See Crown Operations International, Ltd. v. Solutia*, 24 USPQ2d 1917 (Fed. Cir. 2002).

Claims 19-25, 28-31 and 34-36 were rejected under 35 U.S.C. § 103(a) as being unpatentable over U.S. Patent 5,804,518 to Sakatani, *et al.* (referred to herein as "Sakatani"). Sakatani does not render obvious the above claims. In particular, Sakatani fails to suggest a method for polishing that employs an oxidizing agent having a static etch rate on metal of less than 1000 Å per hour and also having a pH of about 5 to about 11 as recited in the present claims. As discussed above, in order to obtain polishing rates that are substantially equal between metal and silicon dioxide, above-pH of the slurry and oxidizing agent are judiciously selected. On the other hand, Sakatani suggests employing a pH of about 7 or less or preferably

about 5 or less along with an oxidizing agent which can be hydrogen peroxide, iron (III) nitrate, iodic acid, iodate, perchloric acid and perchlorate. The preferred oxidizing agents are hydrogen peroxide and iron (III) nitrate. Included among the oxidizing agent such as the hydrogen peroxide and iron (III) nitrate are those that have polishing rates on metals significantly greater than the 1000 Å per hour recited as a maximum in the claims. In addition, none of the examples in Sakatani employ a pH of at least about 5 along with an oxidizing agent having a low static etch rate of less than 1000 Å per hour as recited in the claims. The only examples in Sakatani employing a pH of above 5 are examples 4 and comparative example 8, both of which employ hydrogen peroxide, a strong oxidizer, as the oxidizing agent (for instance, see page 7, line 27-29 of the specification). Moreover, the objective of Sakatani is to have high etch rates for the metal as compared to silicon dioxide. Along these lines, see table 1 and 2 of Sakatani. Accordingly, to include the slurry compositions employed according to the present invention would be contrary to the objectives of Sakatani. Nothing whatsoever in Sakatani would leave one skilled in the art to select a slurry composition having a pH of at least 5 and an oxidizing agent having a static etch rate on metal of less than 1000 Å per hour among all the possible combinations of pH and oxidizing agents suggested in Sakatani. If anything, one skilled in the art would be lead to employ an oxidizing agent having an etch rate on metal as high as possible since that is an objective of Sakatani.

The statement in the Office Action that "it would have been obvious to have the same effect such as same etch rate as claims since all the process constituents such as the abrasive and the oxidizing agent used by Sakatani, *et al.* is exactly similar with the applicant and expected to have the similar effect" is incorrect for the reasons stated above with respect to Wang. In addition, the etch rate referred to in the claims refers to a recitation concerning the particular oxidizing agent to employ. It is the oxidizing agent that has a static etch rate on metal of less than 1000 Å per hour and not a recitation concerning the actual etch rate of the slurry composition itself. Claim 19 has been amended to clarify this.

In addition, the mere fact that the cited art may be modified in the manner suggested by the Examiner does not make this modification obvious unless the cited art suggests a desirability of the modification. No such suggestion appears in the cited art in this matter.

The Examiner's attention is kindly directed to *In re Lee* 61 USPQ2d 1430 (Fed. Cir.

2002) *In re Dembiczak et al.* 50 USPQ2d. 1614 (Fed. Cir. 1999), *In re Gordon*, 221 USPQ 1125 (Fed. Cir. 1984), *In re Laskowski*, 10 USPQ2d. 1397 (Fed. Cir. 1989) and *In re Fritch*, 23 USPQ2d. 1780 (Fed. Cir. 1992).

In Dembiczak et al., supra, the Court at 1617 stated: "Our case law makes clear that the best defense against the subtle but powerful attraction of a hindsight-based obviousness analysis is rigorous application of the requirement for a showing of the teaching or motivation to combine prior art references. See. e.g., C.R. Bard, Inc., v. M3 Sys., Inc., 157 F.3d. 1340, 1352, 48 USPQ2d. 1225, 1232 (Fed. Cir. 1998) (describing 'teaching or suggestion motivation [to combine]' as in 'essential evidentiary component of an obviousness holding'), In re Rouffet, 149 F.3d 1350, 1359, 47 USPQ2d. 1453, 1459 (Fed. Cir. 1998) ('the Board must identify specifically...the reasons one of ordinary skill in the art would have been motivated to select the references and combine them');...".

Also, the cited art lacks the necessary direction or incentive to those of ordinary skill in the art to render under 35 USC 103 sustainable. The cited art fails to provide the degree of predictability of success of achieving the properties attainable by the present invention needed to sustain a rejection under 35 USC 103. See *Diversitech Corp. v. Century Steps, Inc.* 7 USPQ2d 1315 (Fed. Cir. 1988), *In re Mercier,* 185 USPQ 774 (CCPA 1975) and *In re Naylor*, 152 USPQ 106 (CCPA 1966).

Moreover, the properties of the subject matter and improvements which are inherent in the claimed subject matter and disclosed in the specification are to be considered when evaluating the question of obviousness under 35 USC 103. See *Gillette Co. v. S.C. Johnson & Son, Inc.*, 16 USPQ2d. 1923 (Fed. Cir. 1990), *In re Antonie*, 195, USPQ 6 (CCPA 1977), *In re Estes*, 164 USPQ (CCPA 1970), and *In re Papesch*, 137 USPQ 43 (CCPA 1963).

No property can be ignored in determining patentability and comparing the claimed invention to the cited art. Along these lines, see *In re Papesch*, supra, *In re Burt et al.* 148 USPQ 548 (CCPA 1966), *In re Ward*, 141 USPQ 227 (CCPA 1964), and *In re Cescon*, 177 USPQ 264 (CCPA 1973).

The cited references should be considered as a whole, and portions arguing against or teaching away from the claimed invention must be considered. See *Bausch & Lomb, Inc. v.*

*Barnes-Hined/Hydrocurve, Inc.* 230 USPQ 46 (Fed. Cir. 1986). It is improper to take portions of a disclosure out of their proper contect. See *Bausch & Lomb, Inc. v. Barnes-Hind/Hydrocurve, Inc.*, supra.

Attached hereto is a marked-up version of the changes made to the specification and claims by the current amendment. The attached page is captioned **"Version with markings to show changes made."**

In view of the above, each of the presently pending claims in this application is believed to be in immediate condition for allowance. Accordingly, the Examiner is respectfully requested to withdraw the outstanding rejection of the claims and to pass this application to issue.

The Examiner is respectfully requested to enter this Amendment After Final, in that it raises no new issues, but merely places the claims in a form more clearly patentable over the references of record. In the alternative, the Examiner is respectfully requested to enter this Amendment After Final in that it reduces the issues for appeal.

The Director is hereby authorized to charge any fees, or credit any overpayment, associated with this communication, including any extension fees, to CBLH Deposit Account No. 22-0185.

Date: 3-19-03

Respectfully submitted,

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**Version With Markings to Show Changes Made**

**In the Claims:**

Please amend claim 19 as follows:

19. (Amended) A method for polishing a surface, comprising:

providing on said surface a slurry comprising abrasive particles and an oxidizing agent [having] wherein said oxidizing agent has a static etch rate on metal of less than 1000Å per hour; and wherein the pH of the slurry is about [6] 5 to about 11;

and polishing said surface by contacting it with a polishing pad.